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IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
TADAHIKO FURUTA, ET AL.	: EXAMINER: SHEEHAN, J.
SERIAL NO: 10/019,283	:
FILED: JANUARY 2, 2002	: GROUP ART UNIT: 1742
FOR: TITANIUM ALLOY MEMBER	:

DECLARATION UNDER 37 C.F.R. § 1.132

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313-1450

SIR:

I, Tadahiko FURUTA, a citizen of Japan, hereby declare and state that:

1. I graduated from Suzuka College of Technology in 1982.

2. I have been employed since 1982 by Kabushiki Kaisha Toyota Chuo Kenkyusho, where I have been engaged in Materials Science and Engineering.

3. The following experiments were carried out by me or under my direct supervision and control.

4. Outline of Experimental Method

An ingot method (EB: electron beam melting) was used as a method for preparing a raw material. Specifically, as a raw Ti powder, TC459 (-#350) manufactured by TOHO TITANIUM and Nb, Zr (-#350) manufactured by KOUJUNDOKAGAKU were used. Ti powder, Nb powder and Zr powder were scaled to be Ti-30Nb-10Ta-5Zr-0.4O (mass%), and after that, the mixed powder was prepared. The mixed powder was subjected to rotational mixing in a rotational ball mill mixed vessel for 2 hours. After that, the mixed powder was

filled in a vessel, and molded by a CIP pressing machine at a pressure of 4 ton /cm^2. Sintering was carried out in a vacuum at 10^{-5} torr and 1300°C for 4 hours. After sintering, hot forged processing was carried out at 1050°C. A cogging sample that was ϕ 10mm x 100mm was prepared. As preparation for melting, the pressure in a chamber was first reduced to about 10^{-3} Pa, and this degree of vacuum was maintained during melting. The cogging sample was supplied to the chamber from a transverse direction. An electron beam from a first electron beam gun (output: 70-80 kW) was applied to melt the cogging sample, and melting was carried out continuously. Simultaneously, molten metal in a hearth was heated and poured into a mold. The molten metal in the mold was heated by a second electron beam gun (output: 30-40 kW). Then the temperature of the molten metal was continuously decreased, so that the molten metal was cooled and cured in the mold (made of copper), which was cooled by water, thereby obtaining an ingot. The speed of melting was 20kg/h.

T.F. 09/05/18

A ~~cogging sample~~ wrought product that was ϕ 13mm was prepared from the ingot, and a solution heat treatment was carried out at 900°C for 30 minutes. After that, the ~~cogging sample~~ wrought product T.F. 09/05/18 was subjected to cold working by a cold swaging machine and swaged to ϕ 4mm (cold working ratio 90%). A test piece having a plane portion that was ϕ 2mm x 10mm was prepared from the cold working sample, and the test piece was subjected to a tensile test at room temperature. The tensile test was carried out by using an Instron universal testing machine at an early strain rate of 5 x 10^{-4}/sec. Young's modulus was calculated by attaching a strain gage to each test piece.

As a comparative sample, a test piece having a plane portion that was ϕ 2mm x 10mm was prepared from a non-cold working sample (a sample of ϕ 13mm was subjected to a solution heat treatment, but not subjected to cold working), and the same tensile test as above was carried out.

The results are shown in the attached FIG. C. Furthermore, not only the electron beam method but also VAR (Vacuum Arc Remelting) was used as the melting method. In VAR, the same property as that of the electron beam method was obtained.

5. Result of Experiment

The attached FIG. C shows experimental data for the sample before cold working and the sample after cold working.

The attached data relates to Ti-30Nb-10Ta-5Zr-0.4O which is same as Sample No. 1. The cold working sample shows a tensile strength of 1046MPa, a tensile elastic limit strength (0.2% proof stress) of approximately 1000MPa, an average Young's modulus of 48GPa and an elastic deformation of approximately 2.5%. The stress-strain diagram for the cold working sample (melting method) is non-linear which is same as that of the sintering method. This shows the non-linear stress-strain property that is unique to the titanium alloy member of the present invention.

In contrast, the non-cold working sample shows a tensile strength of 800MPa, a tensile elastic limit strength (0.2% proof stress) of 632MPa, a Young's modulus of 77GPa and an elastic deformation of approximately 0.8%. The stress-strain diagram of the non-cold working sample was linear, which is different than the non-linear stress-strain curve of the titanium alloy member of the present invention.

FIG. C shows that cold-working promotes the appearance of non-linear stress-strain properties in the titanium alloy member of the present invention.

6. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

7. Further declarant saith not.

Date: May. 18. 2004

Tadahiko Furuta

Tadahiko FURUTA

Attachment:

FIG. C

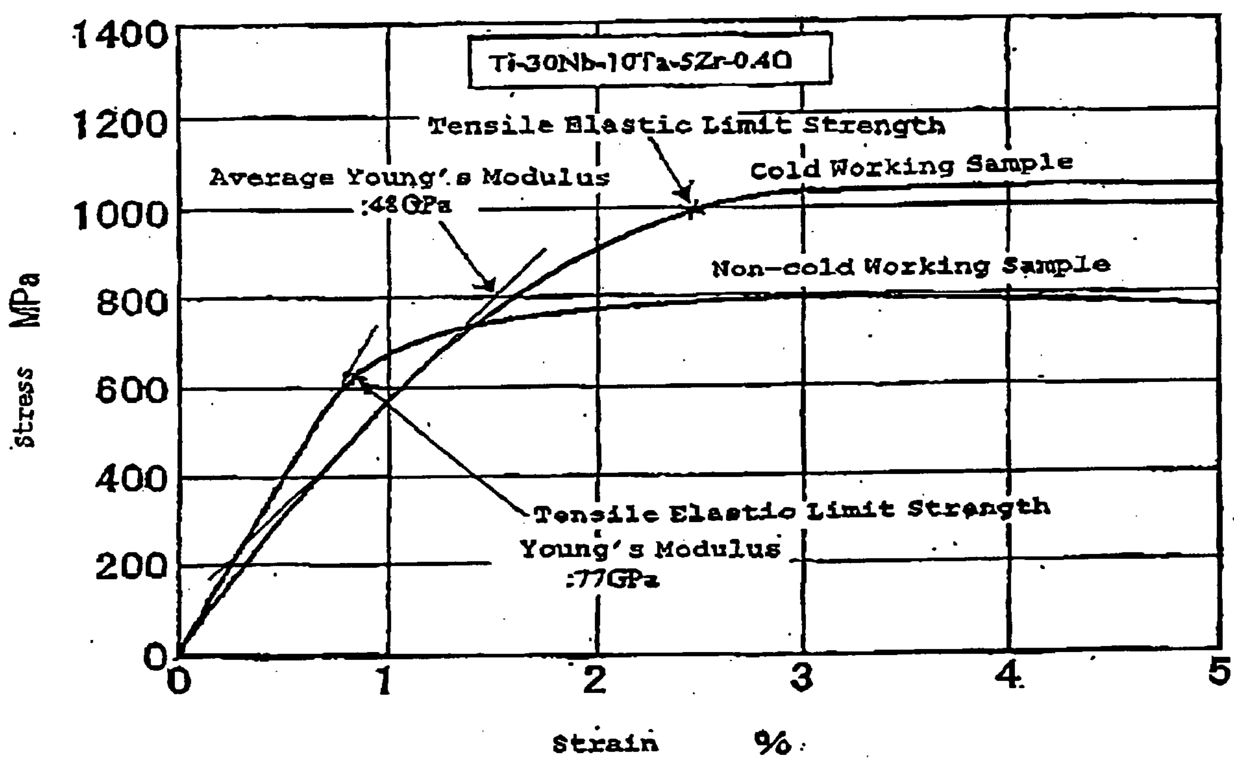
Ti-30Nb-10Ta-5Zr-0.4O
Tensile Elastic Limit Strength
Cold Working Sample
Average Young's Modulus
:48GPa
Non-cold Working Sample
Tensile Elastic Limit Strength
Young's Modulus
:77GPa
1400
1200
1000
800
600
400
200
0
Stress MPa
0
1
2
3
4
5
Strain %

FIG. C